PERENNIAL GRASSLAND

TARGET 1: Restore 4,000 to 6,000 acres (total) of perennial grasses in the North, East, South, and Central and West Delta Ecological Management Units associated with existing or proposed wetlands and floodplain habitats (◆).

PROGRAMMATIC ACTION 1A: Develop a cooperative program to restore 1,000 acres of perennial grassland in the North Delta Ecological Management Unit through either conservation easements or purchase from willing sellers.

PROGRAMMATIC ACTION 1B: Develop a cooperative program to restore 1,000 acres of perennial grassland in the East Delta Ecological Management Unit through either conservation easements or purchase from willing sellers.

PROGRAMMATIC ACTION 1C: Develop a cooperative program to restore 1,000 to 2,000 acres of perennial grassland in the South Delta Ecological Management Unit through either conservation easements or purchase from willing sellers.

PROGRAMMATIC ACTION 1D: Develop a cooperative program to restore 1,000 to 2,000 acres of perennial grassland in the Central and West Delta Ecological Management Unit through either conservation easements or purchase from willing sellers.

RATIONALE: *Restoring wetland, riparian, and adjacent upland habitats in association with aquatic habitats is an essential element of the restoration strategy for this Ecological Management Zone. Eliminating fragmentation and restoring connection of habitats will enhance habitat conditions for special-status species such as the California black rail and foraging habitat for Swainson's hawk. For instance, the habitats for these species have been degraded by a loss of the adjacent escape cover needed during periods of high flows or high tides.*

AGRICULTURAL LANDS

TARGET 1: Cooperatively manage 40,000 to 75,000 acres of agricultural lands (◆◆).

PROGRAMMATIC ACTION 1A: Increase the area of Delta corn fields and pastures flooded in winter and spring to provide high-quality foraging habitat for wintering and migrating waterfowl and shorebirds and associated wildlife.

PROGRAMMATIC ACTION 1B: Periodically flood pasture from October through March in portions of the Delta relatively free of human disturbance to create suitable roosting habitat for wintering greater sandhill crane, and for other wintering sandhill crane subspecies.

PROGRAMMATIC ACTION 1C: Create permanent or semipermanent ponds in Delta farm areas that provide suitable waterfowl nesting habitat but lack suitable brooding habitat, to increase resident dabbling duck production.

PROGRAMMATIC ACTION 1D: Increase the acreage farmed for wheat and other crops that provide suitable nesting habitat for waterfowl and other ground-nesting species in the Delta.

PROGRAMMATIC ACTION 1E: Convert agricultural lands in the Delta from crop types of low forage value for wintering waterfowl, wintering sandhill cranes, and other wildlife to crop types of greater forage value.

PROGRAMMATIC ACTION 1F: Defer fall tillage on corn fields in the Delta to increase the forage for wintering waterfowl, wintering sandhill cranes, and associated wildlife.

PROGRAMMATIC ACTION 1G: Develop a cooperative program to improve management on 8,000 acres of Delta corn and wheat fields and to reimburse farmers for leaving a portion of the crop in each field unharvested as forage for waterfowl, sandhill cranes, and other wildlife.

RATIONALE: *Following the extensive loss of native wetland habitats in the Central Valley, some wetland wildlife species have adapted to the artificial wetlands of some agricultural practices and have become dependent on these wetlands to sustain their populations. Agriculturally created wetlands include rice lands; fields flooded for weed, salinity, and pest control; stubble management; and tailwater circulation ponds.*

Reducing the entrainment of lower trophic organisms (food species) such as phytoplankton and zooplankton, and of life stages of higher trophic organisms such as fish eggs, larvae, and juveniles into agricultural and export water diversions will increase

production of primary and secondary food species. This will also support nutrient cycling functions that can sustain quality forage for aquatic resources in and dependent on the Delta (Chadwick 1974).

Managing agricultural lands to increase forage for waterfowl and other wildlife will increase the survival rates of overwintering wildlife and strengthen them for migration, thus improving breeding success (Madrone Associates 1980; Fredrickson and Reid 1988; Schultz 1990; and, Ringelman 1990).

Restoring roosting habitat in this Ecological Management Zone, especially when it is near forage habitat, will increase the overwinter survival of sandhill cranes and strengthen them for migration, thus improving breeding success. Decreasing in human disturbance in the roosting sites will also improve the health of the crane in the Delta. Actions to restore ecological processes and functions, increase and improve habitats, and reduce stressors are prescribed primarily to increase populations of lower level food species, aquatic and terrestrial invertebrates, and forage fish such as threadfin shad. Improving the foodweb of the Delta will help restore the health of the Bay-Delta's aquatic ecosystem.

Creating small ponds on farms with nearby waterfowl nesting habitat but little brood habitat will increase production of resident waterfowl species when brood ponds are developed and managed properly. Researchers and wetland managers with the DFG, U.S. Fish and Wildlife Service and the California Waterfowl Association have found that well managed brood ponds produce the high levels of invertebrates needed to support brooding waterfowl. Other wildlife such as the red-legged frog, tiger salamander, giant garter snake, and western pond turtle will also benefit. Restoring suitable nesting habitat near brood ponds will increase the production of resident waterfowl species. When the restored nesting habitat is properly managed, large, ground predators are less effective in preying on eggs and young of waterfowl and other ground-nesting birds.

Restoring nesting habitat, especially when it is near brood ponds, will increase the production of resident waterfowl species. When the restored nesting habitat is properly managed, large, ground predators are less effective in preying on eggs and young of waterfowl and other ground nesting birds. Managing agricultural lands to increase forage for waterfowl and other wildlife will increase the overwinter survival rates of wildlife and strengthen them for migration, thus improving breeding success (Madrone and Assoc. 1980; Fredrickson and Reid 1988; Schultz 1990; and Ringelman 1990). Following the extensive loss of native upland habitats, upland wildlife species have adapted to the artificial upland environment of some agricultural land uses and have become dependent on agricultural upland areas and field-border shelter belts to sustain their populations.

Habitat restoration will occur over a 30 year period. Initial efforts will be directed at lands presently in State or Federal ownership. Restoration will be strictly guided by adaptive management in which conceptual ecosystem models and hypotheses will be developed. Small projects will be implemented to test the hypotheses regarding habitat restoration. For example, one hypothesis might be that delta smelt will occupy tidal perennial aquatic habitat for foraging, spawning, and rearing. Monitoring will determine it the hypothesis is true or false (e.g., do delta smelt use restored habitat). Based on the results of monitoring under the adaptive management program, an evaluation will be made regarding the need and benefit of restoring additional acres of tidal perennial aquatic habitat.

The Delta Protection Commission suggested (letter to CALFED dated July 10, 1998) some alternatives for meeting habitat restoration targets in the Delta. Although it is premature to set priorities for the targets and programmatic actions in the Delta, the Commission suggested the following approaches:

- *Restore and/or enhance lands currently in public or non-profit ownership (or currently in the acquisition process) and designated for restoration, including Twitchell Island, Sherman Island, and Prospect Island. Approximately 35,000 acres fall into this category.*
- *Acquire and/or enhance currently flooded lands to create and/or enhance emergent habitat, including Frank's Tract, Big Break, Mildred Island, Little Mandeville Island, etc. Approximately 7,000 acres fall into this category.*
- *Develop and implement management plans for upland areas already in public or non-profit ownership, including Calhoun Cut Ecological*

Preserve (approximately 1,000 acres), Rhode Island, etc.

- Develop and implement individual management plans for private agricultural properties and develop (or provide) funds to offset costs of voluntary implementation of such plans (plans could include flooding programs, enhanced levees and pumps to enhance flooding and drainage, recommend crop rotation cycles, size and location of permanent brood ponds, etc.).
- Develop and implement individual management plans for privately owned lands managed for wildlife habitat, such as duck clubs and upland hunting clubs, and develop (or provide) funds to offset costs of voluntary implementation of such plans.
- Control of stressors should be revised to avoid duplication with existing regulatory programs, such as existing dredging "windows," and the programs that are developed should respect the needs of existing land uses, such as water-oriented recreation. Where funds are needed to carry out specific programs, those funds should be made available to private land owners to implement CALFED programs.

The Delta Protection Commission also suggested the approach for restoring a riparian corridor along the Delta portion of the Sacramento River should consider the ecological benefits of enlarging and enhancing a riparian corridor west of the Deep Water Ship Channel, within the Yolo Bypass. Such a waterway could connect to the main stem of the Sacramento River at either or both the Sutter Weir or the Sacramento Weir. There is an existing channel named the Tod Drain, which lies west of the Ship Channel. The Toe Drain is largely unvegetated by lies within the Yolo Bypass, where the lands are already subject to a flood easement purchased by the federal government to provide additional flood protection the city of Sacramento and the Delta area. While the Sacramento River can maintain flood flows of about 150,000 cfs, the Yolo Bypass can handle about three times as much flood flow (450,000 cfs). Locating an enhanced riparian corridor within the Yolo Bypass would also address the stranding of juvenile and adult fish when flood flows recede. Creating an enlarged channel would improve flood water conveyance capacity in the Yolo Bypass, which would then allow the introduction and maintenance of riparian vegetation into the flood bypass without reducing overall flow capacity during flood events.

The Delta Protection Commission also suggested that the South Fork of the Mokelumne River be considered for water conveyance and flood control, by dividing the flow of the Mokelumne River between its north and south forks. Both forks could be examined for additional habitat restoration opportunities as channel capacities are increased by dredging or construction of any necessary levee setbacks. There are significant flow constrictions in the upper reach of the South Fork Mokelumne, which if reduced, could provide important opportunities for flood control and habitat restoration. The Commission suggested that the Mokelumne River corridor must be multipurpose and provide water conveyance through the Delta, flood control for Sacramento and San Joaquin counties, and provide for a riparian corridor for aquatic and terrestrial species.

The Commission also provided information regarding wildlife friendly farming practices. In 1993-94, a Crop Shift Demonstration Project was conducted on Rindge Tract. More recently, short-season rice has been successfully grown in the Delta and could be a valuable crop that contributes to wildlife friendly agricultural practices. The California Department of Fish and Game recommended specific measures to mitigate impacts to wildlife from the demonstration project. Most of the mitigation measures were implemented as part of the demonstration project, and project monitoring provided positive results. Based on this demonstration project, a wildlife friendly agricultural practices program should consider the following:

- Extend availability of post-harvest flooded grain fields to more fully cover period of usage by migratory birds.
- Enhance food value of post-harvest flooded grain fields by intentionally leaving more grain in the fields either by modifying harvest practices or intentionally not harvesting portions of the fields to be harvested.
- Create fringe areas during important periods to enhance forage opportunities for species such as greater sandhill cranes and Swainson's hawks.

Table 6. Summary of ERPP Habitat Restoration Targets for the Sacramento-San Joaquin Delta Ecological Management Zone.

Habitat Type	North Delta Acreage	East Delta Acreage	South Delta Acreage	Central and West Delta Acreage	Total Acreage
Tidal Perennial Aquatic	1,500	1,000	2,000	2,500	7,000
Shoal	0	0	0	500	500
Nontidal Perennial Aquatic (deep open water)	0	200	200	100	500
Nontidal Perennial Aquatic (shallow open water)	1,000	300	300	500	2,100
Delta Sloughs	10-30 miles (61-182 acres)	10-30 miles (61-182 acres)	25-50 miles (152-303 acres)	20-50 miles (121-303 acres)	65-160 miles (395-970 acres)
Delta Sloughs (Yolo Bypass)	50-100 miles (303-606 acres)	--	--	--	50-100 miles (303-606 acres)
Midchannel Islands	50 to 200	50 to 200	50 to 200	50 to 200	200 to 800
Fresh Emergent Wetland (tidal)	TBD [to be determined]	TBD	TBD	TBD	30,000 to 45,000
Fresh Emergent Wetland (nontidal)	2,000	1,000	4,000	10,000	17,000
Seasonal Wetland	Improve: 1,000 Restore: 2,000	1,000 6,000	500 12,000	1,500 8,000	4,000 28,000
Riparian and Riverine Aquatic	20-35 miles plus 500 acres (691-1,009 acres)	8-15 miles (116-218 acres)	25-45 miles (377-695 acres)	--	53-96 miles plus 500 acres (1,684-2,422 acres)
Inland Dune Scrub	0	0	0	50 to 100	50 to 100
Perennial Grassland	1,000	1,000	1,000 to 2,000	1,000 to 2,000	4,000 to 6,000
Wildlife Friendly Agricultural Land	TBD	TBD	TBD	TBD	40,000 to 75,000
Total acres of all habitats to be restored excluding wildlife friendly agricultural practices					91,732 to 110,998

- *Disperse the program throughout the Delta to discourage over-concentration of species in a single area.*

Maintain the existing agricultural economy of the region by using a voluntary program in which participants receive compensation equal to their cost or loss of income.

Overall, the Delta Protection Commission has provided suggestions that will facilitate implementation of the long-term program. Although the recommended actions in this plan are still at the "Programmatic Level," near-term implementation plans and projects can incorporate these suggestions in order to develop actions that can be implemented with support of the Commission.

Reducing or Eliminating Stressors

Water Diversions

Target 1: Reduce loss of important fish species at diversions (◆◆◆).

Programmatic Action 1A: Consolidate and screen agricultural diversions in the Delta.

Programmatic Action 1B: Replace or upgrade the screens at the SWP and CVP intakes with positive-barrier, fish bypass screens and state-of-the-art fish holding and transportation systems. *(Note: The ecological benefits of this action could be substantially improved by selection of an alternative that has a provision to relocate the intakes, screening those intakes, and providing for fish bypasses as needed.)*

Programmatic Action 1C: Upgrade screens at Pacific Gas & Electric Company's Contra Costa power plant with fine-mesh, positive barrier, fish bypass screens.

Rationale: *Loss of juvenile fish in diversions is detrimental to fish species of special concern (Larkin 1979; Erkkila et al. 1950).*

Levees, Bridges, and Bank Protection

Target 1: Increase shoreline and floodplain riparian habitat in the Delta by changing the vegetation maintenance practices on both the water and the land side of berms on 25 to 75 miles of the Sacramento, Mokelumne, and San Joaquin rivers, and on 25 to 100 miles of other Delta channels and sloughs confined by levees (◆◆).

Programmatic Action 1A: Enter into agreements with willing levee reclamation districts to change levee and berm vegetation management practices that to establish and mature shoreline riparian vegetation. This will restore and maintain the health of Delta aquatic resources. Reimburse districts for any additional maintenance and inspection costs.

Rationale: *Restoring, improving, and protecting high-quality riparian woodland and willow scrub habitat will enhance nutrient cycling and the foodweb and provide habitat for terrestrial invertebrates that will sustain resident fish and juvenile anadromous fish. Terrestrial vertebrates that will benefit include the Swainson's hawk, western yellow-billed cuckoo, neotropical migrant songbirds, and the riparian brush rabbit. This action will also increase suitable habitat for wildlife such as the western pond turtle and wood duck (Bjornn et al. 1991; Shields et al. 1993; Jensen et al. 1987; Fris and DeHaven 1993; Mahoney and Erman 1984; and Knight and Bottorff 1983). Large-scale riparian restoration projects are needed to restore the variety of species and the sustainability and resilience of these habitats to support the ecological functions needed for aquatic resource restoration in the Bay-Delta. This is consistent with the recommended strategy for restoration of rivers and aquatic ecosystems on a large scale (National Research Council 1992; Noss and Harris 1986; Hutto et al. 1987; Scott et al. 1987; Noss et al. 1994).*

Dredging and Sediment Disposal

Target 1: Limit dredging in channel zones that are not essential for flood conveyance or maintenance of industrial shipping pathways, and avoid dredging in shallow water areas (depths of less than 3 meters at mean high water) except where it is needed to restore flood conveyance capacity (◆◆◆).

Programmatic Action 1A: Use alternate sources (rather than Delta in-channel sources) of levee maintenance material, such as:

- excavation of abandoned nonessential levees,
- excavation material from the restoration of secondary tidal channels,

- dry-side island interior borrow pits,
- upland borrow sites,
- Cache Creek settling basin and Yolo Bypass sediment deposits, and
- deep water dredging sites in the San Francisco Bay.

PROGRAMMATIC ACTION 1B: Restrict or minimize effects of dredging near existing midchannel islands and shoals that are vulnerable to erosion and exhibit clear signs of area reduction from channel and bar incision (cutting).

TARGET 2: Avoid dredging during spawning and rearing periods for delta smelt and during rearing periods for winter-run chinook salmon (◆◆◆).

PROGRAMMATIC ACTION 2A: Follow DFG guidelines for dredging in the estuary.

PROGRAMMATIC ACTION 2B: Provide stockpiles of levee maintenance materials in three or more selected land-side areas to avoid the need to obtain material from Delta channels during restricted periods.

RATIONALE: *Soils for levee maintenance should not be taken from adjacent Delta waters because such dredging alters the physical and chemical characteristics of the aquatic habitat and disrupts aquatic organisms. Restoring, improving, and protecting high-quality shallow habitat will provide forage for rearing juvenile fish. These areas typically produce high levels of primary and secondary food species and support nutrient cycling that can sustain quality forage. These areas also provide high-quality forage for waterfowl that use submerge vegetation growing in the shoals and diving ducks such as canvasback and scaup that eat clams in these areas (Fris and DeHaven 1993; Britain et al. 1993; Stuber 1984). Losses or impacts to this habitat should be avoided to restore the health of the estuary (Schlosser 1991; Sweetnam and Stevens 1993; Herbold 1994).*

Impacts that could disrupt foraging and breeding activities of special-status estuarine fish should be avoided (Sweetnam and Stevens 1993; Moyle et al. 1992, Herbold 1994).

INVASIVE AQUATIC PLANTS

TARGET 1: Manage existing and restored dead-end and open-ended sloughs and channels within the Sacramento-San Joaquin Delta Ecological Management Zone so that the total surface area of these sloughs and channels covered by invasive non-native aquatic plants is reduced (◆).

PROGRAMMATIC ACTION 1A: Conduct large-scale, annual weed eradication programs throughout existing and restored dead-end and open-ended sloughs and channels within each of the Delta's Ecological Management Units. The goal is that less than 1% of the surface area of these sloughs and channels is to be covered by invasive non-native aquatic plants within 10 years.

PROGRAMMATIC ACTION 1B: Evaluate the feasibility of developing a program to commercially harvest and convert water hyacinth to methane (natural gas) and organic fertilizer.

TARGET 2: Reduce the potential for introducing non-native aquatic plant and animal species at border crossings (◆◆◆).

PROGRAMMATIC ACTION 2A: Provide funding to the California Department of Food and Agriculture to expand the current State border inspection process to include a comprehensive program of exclusion, detection, and management of invasive aquatic species such as purple loosestrife, and hydrilla.

RATIONALE: *Invasive aquatic plants have altered ecosystem processes, functions, and habitats through a combination of changes such as those to the foodweb and those from competition for nutrients, light, and space. The prescribed action is primarily to enhance foodweb functions and improve habitat for resident, estuarine, and anadromous fish and neotropical migratory birds, in part, by reducing the areas inhabited by invasive non-native plants and by large-scale restoration of optimal nesting habitat (Dudley and D'Antonio 1994; Anderson 1990; Zedler 1992; Bay-Delta Oversight Council 1994).*

INVASIVE RIPARIAN AND SALT MARSH PLANTS

TARGET 1: Reduce surface area covered by non-native plants to less than 1% (◆).

PROGRAMMATIC ACTION 1A: Control non-native riparian plants.

TARGET 2: Reduce the area of invasive non-native woody species, such as Giant Reed (i.e., Arundo or

false bamboo) and eucalyptus, that compete with native riparian vegetation, by reducing the area of non-natives by 50% throughout the Delta and by eradicating invasive woody plants from restoration areas (◆◆).

PROGRAMMATIC ACTION 2A: Implement a program throughout the Delta to remove and suppress the spread of invasive non-native plants that compete with native riparian vegetation by reducing the aerial extent of species such as False Bamboo, eucalyptus, and non-native cordgrass (Spartina spp.) by 50%.

PROGRAMMATIC ACTION 2B: Implement a program throughout the Delta that, before restoration actions, eliminates invasive woody plants that could interfere with the restoration of native riparian vegetation.

RATIONALE: *Invasive non-native plants have altered ecosystem processes, functions, and habitats through a combination of changes such as those to the foodweb and those of competition for nutrients, light, and space. The prescribed actions are primarily to improve habitat for many fish and wildlife species and to support foodweb functions by establishing extensive riparian habitat throughout the Delta (Dudley and D'Antonio 1994; Madrone and Assoc. 1980; Bay-Delta Oversight Council 1994; Cross and Fleming 1989; Zedler 1992). There have been extensive Spartina eradication efforts in Willapa Bay, Washington, that could provide guidance in designing and implementing a similar control program in the western Delta and north San Francisco Bay. In most cases, the removal of invasive plants will require the replanting of native vegetation to maintain adequate levels of herbaceous cover, canopy closure, habitat structure, and to limit exotic recolonization.*

INVASIVE AQUATIC ORGANISMS

TARGET 1: Reduce or eliminate the influx of non-native aquatic species in ship ballast water (◆◆◆).

PROGRAMMATIC ACTION 1A: Fund additional inspection staff to enforce existing regulations.

PROGRAMMATIC ACTION 1B: Help fund research on ballast water treatment techniques that could eliminate non-native species before ballast water is released.

TARGET 2: Reduce the potential for introducing non-native aquatic organisms at border crossings (◆◆◆).

PROGRAMMATIC ACTION 2A: Provide funding to the California Department of Food and Agriculture to expand the current State border inspection process to include a comprehensive program of exclusion, detection, and management of invasive aquatic species such as the zebra mussel.

RATIONALE: *Every reasonable effort should be made to reduce the introduction of non-native organisms in the ballast water of ships that enter the Delta. Such organisms have greatly altered the zooplankton of the Delta over the past several decades. Further alteration could reduce the capacity of the Delta to support native fishes.*

Every reasonable effort should be made to reduce the introduction of non-native organisms at overland entrances to California. Inspections at borders have already found Zebra mussels that if allowed to enter Bay-Delta waters could have devastating economic and ecological effects.

PREDATION AND COMPETITION

TARGET 1: Reduce loss of juvenile fish in Clifton Court Forebay to predation by 75% to 90% (◆◆◆).

PROGRAMMATIC ACTION 1A: Evaluate alternate operational strategies to reduce entrainment of juvenile fish into Clifton Court Forebay.

TARGET 2: Reduce in-channel predation loss of juvenile fish near structures such as bridge pilings and diversions (◆).

PROGRAMMATIC ACTION 1A: Develop a cooperative program to reevaluate opportunities to modify in-channel structures to eliminate predator habitat.

RATIONALE: *Diversions and other structures may provide habitat or opportunities for predatory fish and wildlife, which could be detrimental to fish species of special concern (Erkkila et al. 1950).*

Predation of juvenile fish in Clifton Court Forebay is a symptom of larger problems. These are probably insufficient rearing habitat in the Central Delta, high channel velocities, and insufficient flows in the San Joaquin River. Short-term efforts in Clifton Court Forebay should include, at a minimum, a predator

removal or control program near the fish facility and louver system. Additional focused research is needed on longer-term efforts to reduce predation and to improve the understanding of predator population growth. The longer-term solution to predation at this site lies in re-creating rearing and migration habitats throughout the Delta. Some of the water conveyance alternatives in the Delta could decrease the rates of predation by enlarging the forebay and closing the radial gates for longer periods.

CONTAMINANTS

TARGET 1: Reduce loading, concentrations, and bioaccumulation of contaminants of concern to ecosystem health in the water, sediments, and tissues of fish and wildlife in the Sacramento-San Joaquin Delta Ecological Management Zone by 25 to 50% as measured against current average levels (◆◆).

PROGRAMMATIC ACTION 1A: Reduce the input of herbicides, pesticides, fumigants, and other agents toxic to fish and wildlife in the Delta by changing land management practices and chemical uses on 50,000 acres of urban and agricultural lands that drain untreated into Delta channels and sloughs. Actions will focus on modifying agricultural practices and urban land uses on a large scale. To reduce the concentration of pesticide residues, the amount applied will be reduced and the amount of pesticide load reaching the Delta's aquatic habitats will be further reduced by taking advantage of biological and chemical processes within wetland systems to help break down harmful pesticide residues.

PROGRAMMATIC ACTION 1B: Reduce levels of hydrocarbons and other contaminants entering the Delta foodweb from high releases into the estuary at oil refineries.

RATIONALE: *Reducing the concentrations and loads of contaminants including hydrocarbons, heavy metals, and other pollutants in the water and sediments of the Sacramento-San Joaquin Delta Ecological Management Zone will help ensure reduction of sublethal and chronic impacts of contaminants, whose impacts on population levels are hard to document. (Bay Delta Oversight Council 1994; Hall 1991; U.S. Fish and Wildlife Service 1996; San Francisco Estuary Project 1992b; Sparks 1992; Diamond et al. 1993; Rost et al. 1989). Improved inchannel flows within the Delta from seasonal reductions in water use and improved flows attributed to enhanced supplies of environmental water will also contribute to reducing concentrations (Charbunneau and Resh 1992; U.S. Environmental Protection Agency 1993). Human health warnings associated with consuming fish and wildlife have been issued because of high levels of substances such as mercury and selenium. Large-scale restoration of aquatic and wetland habitats may contribute to reducing levels of hydrocarbons, heavy metals, and other pollutants. However, addressing point sources of concern such as the oil refineries on Suisun and San Francisco Bays and elevated releases of selenium as a result of refining oil from sources high in selenium can also help reduce these contaminants (Charbunneau and Resh 1992).*

HARVEST OF FISH AND WILDLIFE

TARGET 1: Reduce illegal harvest of anadromous fish and wildlife in the Delta by increasing enforcement (◆◆◆).

PROGRAMMATIC ACTION 1A: Provide additional funding to the DFG for additional enforcement.

PROGRAMMATIC ACTION 1B: Provide additional funding to local county sheriff's departments and local park agencies for additional enforcement.

PROGRAMMATIC ACTION 1C: Provide rewards for the arrest and conviction of poachers.

RATIONALE: *Actions to reduce illegal harvest of fish and wildlife are prescribed primarily to contribute to the recovery of aquatic species such as winter-run, spring-run, and late fall-run chinook salmon; green sturgeon; splittail; and steelhead. They will also contribute to the recovery of species such as Swainson's hawk, greater sandhill crane, yellow-billed cuckoo, riparian brush rabbit, black rail, and giant garter snake (U.S. Fish and Wildlife Service 1996; San Francisco Estuary Project 1992b; Bay-Delta Oversight Council 1993; California Department of Fish and Game 1991).*

STRANDING

TARGET 1: Reduce or eliminate the stranding of juvenile chinook salmon on floodplains, shallow ponds, and levee borrow areas (◆◆).

PROGRAMMATIC ACTION 1A: Conduct surveys of stranding in the Yolo Bypass under a range of flow conditions and develop recommendations to resolve the problem.

RATIONALE: *Under many flow conditions, stranding is likely in the Yolo Bypass and is a minimal problem. However, under conditions in which the Sacramento River reach high flows and flow is diverted into the flood bypasses, and then flow quickly recede, stranding is likely a serious problem. Timing also plays a important role in determining the severity of the problem. The California Department of Water Resources has been investigating stranding of juvenile fish in the Yolo Bypass and identified areas where remedial actions are probably appropriate to reduce the loss of juvenile fish. Further analysis is needed of the potential magnitude of the problem and additional options to reduce the potential severity of the problem need to be identified.*

DISTURBANCE

TARGET 1: Reduce boat traffic and boat speeds in areas where levees or channel islands and their associated shallow-water and riparian habitat may be damaged by wakes. This will protect important Delta habitats such as berm islands from erosion caused by boat wake (◆◆).

PROGRAMMATIC ACTION 1A: In the Central and West Delta Ecological Management Unit, establish and enforce no wake zones of 1 to 3 miles in Disappointment Slough, of 1 to 2 miles in White Slough, and of 3 to 4 miles in Middle and Old rivers in areas with remnant berms and midchannel islands.

PROGRAMMATIC ACTION 1B: In the East Delta Ecological Management Unit, establish and enforce no wake zones of 1 to 3 miles of the Mokelumne River, of 2 to 4 miles in Snodgrass Slough, and of 3 to 4 miles in Beaver, Hog, and Sycamore Sloughs in areas with remnant berms and midchannel islands.

TARGET 2: Reduce boat wakes near designated important California black rail nesting areas in the Delta from March to June to levels necessary to prevent destruction of nests. This will help in recovery of this listed species (◆◆).

PROGRAMMATIC ACTION 2A: Establish and enforce no wake zones within 50 yards of important California black rail nesting areas in the Delta from March to June.

PROGRAMMATIC ACTION 2B: Establish and enforce no motorized boating zones in 5 to 25 miles of existing dead-end channels in the Delta from March to June.

PROGRAMMATIC ACTION 2C: Establish and enforce no motorized boating zones in the small tidal channels created in restored tidal freshwater marshes and Delta floodplains of levee setbacks.

TARGET 3: Reduce boat wakes near important shallow water spawning areas in the Delta from March to June to levels necessary to protect successful spawning behavior and success. This will help in recovery of listed species (◆).

PROGRAMMATIC ACTION 3A: Identify important shallow water spawning areas and establish and enforce no wake zones within 50 yards of these important Delta habitats from March to June.

RATIONALE: *Protecting the highest quality and largest berm island complexes will advance the ERPP's strategy of protecting and restoring large areas of habitat rather than small fragmented areas (National Research Council 1992; Resource Agency 1976; San Francisco Estuary Project 1992a; San Joaquin County 1979; U.S. Fish and Wildlife Service 1992).*

Actions taken to restore ecological processes and functions, increase and improve habitats, and reduce stressors in this Ecological Management Zone are prescribed primarily to contribute to the recovery of aquatic species such as winter-run, spring-run, and late-fall-run chinook salmon; green sturgeon; splittail; and steelhead. They will also contribute to the recovery of species such as the black rail. (Madrone 1980; Schlosser 1991; San Francisco Estuary Project 1992a; U.S. Fish and Wildlife Service 1978; Schlorff 1991).

Additional research is needed to identify important shallow water spawning areas and the potential adverse effects of boat traffic on the spawning success of native Delta fishes.

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